DOCUMENT RESUME

ED 270 213 PS 015 845

AUTHOR Strand, Elizabeth; And Others
TITLE A Descriptive Study Comparing Preschool and Kindergarten LOGO Interaction.
PUB DATE 19 Apr 86
NOTE 54p.; Paper presented at the Annual Meeting of the American Educational Research Association (70th, San Francisco, CA, April 16-20, 1986).
PUB TYPE Reports - Research/Technical (143) -- Speeches/Conference Papers (150)

EDRS PRICE MF01/PC03 Plus Postage.
DESCRIPTORS *Behavior Patterns; *Classroom Communication; Classroom Observation Techniques; Comparative Analysis; *Computer Assisted Instruction; Early Childhood Education; *Interpersonal Relationship; *Kindergarten Children; Language Skills; *Preschool Children
IDENTIFIERS Collaborative Learning; *LOGO System; Microethnography

ABSTRACT

Aware of some educators' concerns that computers isolate children and are too abstract for chilren under the age of eight, two studies investigated young children's use of LOGO and their interactions with the computer. Data were collected on kindergartners working in a public school computer lab and on preschoolers using computers in a university-based computer classroom. Using a case study approach, the analysis focused upon what two kindergarteners and two preschoolers said and did while computing. The findings revealed that for the kindergarten children, LOGO facilitated collaborative behavior and enhanced the expression of social and language skills. For the preschoolers, LOGO encouraged highly focused task-related behavior, but did not invite collaborative learning. (Author/HOD)

****
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
****

U.S. DEPARTMENT OF EDUCATION
Office of Educational Research and Improvement
EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)

X This document has been reproduced as received from the person or organization originating it.

☐ Minor changes have been made to improve reproduction quality.

• Points of view or opinions stated in this document do not necessarily represent official OERI position or policy.

ED270213

A DESCRIPTIVE STUDY COMPARING PRESCHOOL AND KINDERGARTEN LOGO INTERACTION

Elizabeth Strand, Barbara Gilstad,
Pamela McCollum, and Celia Genishi
Department of Curriculum and Instruction
University of Texas
Austin, TX 78712-1294

"PERMISSION TO REPRODUCE THIS MATERIAL HAS BEEN GRANTED BY

Elizabeth Strand

TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)."

PS 015845

Paper presented at the annual meeting of the American Educational Research Association, April 19, 1986, San Francisco, California.

Abstract

In two studies of young children using LOGO, children's interactions with the computer and with each other were investigated. Data were collected on kindergarteners working in a public school computer lab and on preschoolers using computers in a university-based computer classroom. Using a case study approach, the researchers focused upon what two kindergarteners and two preschoolers said and did while computing. The findings reveal that for the kindergarten children, LOGO facilitated collaborative behavior and enhanced the expression of social and language skills. For the preschoolers, LOGO encouraged highly focused task-related behavior, but did not invite collaborative learning.

Introduction

The purpose of this paper is to report on two ongoing investigations of computers and LOGO in early childhood education. Aware of some educators' concerns that computers isolate children and are too abstract for children under the age of eight, we undertook studies of what young children actually do while computing.

To this point, both studies have focused on the oral language that occurs while the children are interacting with the computer hardware and software, as well as what occurs between the children and the teacher and among the children themselves. The data for the first study were collected during a three-month period in the spring of 1984 in a public elementary school in Austin, Texas. First grade and kindergarten students were videotaped using LOGO, a computer language designed to teach geometric principles (Papert, 1980). Results to this point have shown that LOGO provided a rich context for communication where highly cooperative and task-related talk flourished (Genishi, McCollum, Strand, & Hamilton, 1985).

Continued analysis of the kindergarten videotapes has focused on the following questions: (a) How much time do children actually spend engaged with the computer vs. time spent in other activities?, (b) what is the nature of their talk in terms of communicative function? (e.g., reporting, directing, requesting, etc.), (c) how is help requested and given?, and (d)

does the use of computer related language cause communication problems and if so, when and in what contexts does it occur?

The preschool study evolved quite naturally from the initial research. Discovering the ease with which some of the children used LOGO and the rich communicative context it provided, led us to question whether it would be an appropriate medium of instruction for 4- and 5- year-olds. Six preschool children were videotaped during hour-long sessions on Saturday mornings when they were introduced to LOGO in a special computer laboratory for ten weeks during the summer of 1985. They were instructed by one of the investigators from the initial study. The research questions were:

1. To what extent are young children engaged with the computer and how can their working styles be characterized?
2. What is the nature of their behavior when they are not engaged with the computer?
3. What is the nature of their talk in terms of communicative function, and the nature of their interaction when they are seeking and giving help?
4. How do the preschool children and kindergarten children compare on the above variables?

For this paper examples of how kindergarteners and preschoolers behave and use language as they go about learning LOGO in a computer laboratory will be compared. It should be noted that the preschool study is not a replication of the first study. For that reason, there will not always be exact correspondences in the data reported. The differences and the similarities across levels will be reported to give the reader a

feeling for how young children talk and work together while using LOGO.

To do this we have chosen to present the results of our analysis along with vignettes of how each child went about learning LOGO.

Review of the Literature

LOGO is a programming language associated with children because of its graphic capabilities and its ease of learning. LOGO's drawing device is referred to as a turtle, a small triangular shape which appears on the computer screen. It "draws" in response to commands, the most basic of which cause the turtle to move forward, back, right, or left. A geometric shape can be drawn by directing the turtle to move in response to a succession of direction and distance commands. For instance, a square can be drawn by instructing the turtle to move forward a certain number of steps (e.g. FORWARD 50), telling it to turn a certain number of degrees (e.g. RIGHT 90), then repeating these instructions three more times to complete the sides of the square. Through the process of teaching the turtle to draw a geometric design, Papert (1980) claims that a child learns, at an intuitive level, some of the mathematics inherent in Euclidean geometry. Because LOGO offers children an opportunity to control the computer for their own purposes, Papert contends that it is a motivating and engaging activity.

Young Children's Use of LOGO

Typically, pre-readers are introduced to a single keystroke program, commonly referred to in the literature as Easy LOGO or Instant LOGO. The turtle in Instant LOGO has been pre-programmed to move forward, backward, or turn in response to the pressing of single keys, usually marked with the letters F,B,R, and L so that they can be easily identified.

Studies involving young children, usually kindergarteners, have shown that they can use Instant LOGO with varying degrees of success to direct the turtle towards a target on the screen, through mazes, and to draw geometric designs by pressing the appropriate keys (e.g. Campbell, Fein, Scholnick, Frank, & Scholnick, 1985; Munro-Mavias, 1983; Schwartz & Leibson, 1985). While findings have shown that young children can learn to successfully use Instant LOGO, not much is known about the ways in which children learn LOGO or the effect it has upon their learning.

Social Outcomes of LOGO Learning

Researchers have found that the use of LOGO can encourage the interaction among all participants and offer opportunities for collaborative teaching and learning. For example, Hawkins, Sheingold, Gearhart, & Berger (1982) report that the tendency of 8- to 11-year-olds to work cooperatively on LOGO projects was greater than during other classroom tasks. In addition, Kull (1985) observed a great deal of sharing and mutual assistance among first graders learning LOGO and Genishi et al. (1985)

found a high incidence of task-related cooperative talk among kindergarteners using LOGO.

The social activity exhibited by elementary school children has also been demonstrated by preschool children using computers (Muller & Perlmutter, 1985; Piestrup, 1982; Swigger, 1983). Muller and Perlmutter (1985), for example, found that preschool children collaborated more with their peers while working on a computer than while working puzzles. Rosengren, Gross, and Abrams (1985) have addressed the question of whether social interaction is stimulated by the novelty of the computer, or the computer itself. They found that the computer environment continued to be a socially active one, even after the computer had been in a preschool classroom for over a year. It should be noted that in the case of the preschool studies, the children were not using LOGO, but software that included instructional games and graphic programs. It would seem that the computer's features, in particular the public nature of children's activity on the screen, accounts for the facilitation of social interaction.

Though social interaction has been found to occur in computing environments, the exact nature of this interaction is just beginning to be examined. As yet, little is known about how children use language and behave as they learn LOGO. Furthermore, not much is known about how individual learning styles or the educational context can affect social interaction. Papert (1980) maintains that LOGO encourages involvement with

the computer, as well as others. This study purports to investigate the extent to which individual children respond to the holding power of the computer and engage in social interaction, and describe the nature of this engagement and interaction.

Methodology

The methodology used for both studies is microethnography. The basic premise of microethnography is that participants in interactions have definitions of roles and statuses and standards of acceptability, discoverable through close analysis of face-to-face interactions contained on videotape. It is assumed that people engaged in face-to-face interaction are constantly signalling each other about what is happening or about to happen both verbally and nonverbally. Through careful examination of their modes of signalling each other, one can discover the rules that govern the interaction (Erickson, 1982; Erickson & Shultz, 1977; Mehan, 1979).

Microethnography is particularly well suited for studying learning from a Vygotskyian perspective. Within that framework, it is impossible to separate children's learning from the context in which it is embedded. Videotape records of naturally occurring interactions allow the researcher the following advantages: (a) the ability to return repeatedly to the original interaction to verify inferences, (b) a record of the nonverbal channel of communication, and (c) the ability to

verify inferences and theories about the interaction by having the participants themselves confirm or disconfirm them.

Microethnographic methods are labor intensive and generally follow these steps. First, small groups of people are videotaped naturally occurring events. At this time, observations are recorded in the form of field notes in order to interpret the behavior on the tape within a wider socio-cultural framework. Second, copies of the videotapes are made and a time-date generator is used to superimpose the date and time on the tapes. The digital numbers allow the researcher to accurately locate and measure the duration and the amount of time between events in real time. The third step entails making detailed transcripts of all the talk contained on the tape. Generally, significant nonverbal behavior is noted within parentheses on the transcripts next to the utterance which accompanies it. Steps 1-3 involve data collection and the preparation of data for analysis.

Step 4, data analysis, consists of repeated viewing of the videotapes in order to identify, classify, and sort events which occur in the interactions. It stresses exhaustiveness of data treatment in that the flow of interaction is viewed holistically in an attempt to isolate social rules which describe the event contained on tape. Erickson (1982) stresses the im,ortance in educational research of investigating how and where the academic content of a lesson leads to the suspension of normal social rules in interactions.

Initial Study

Subjects. One class of kindergarteners and one class of first graders were videotaped as they used LOGO in a computer lab in a public elementary school. This paper will report on two focal children from the kindergarten class. The six children, three boys and three girls, who were taped were high achievers in Miss Smith's class as well as "leading edgers" (Kull, 1985) in the computer lab. She reported that four of them could read upon entering kindergarten. All of the kindergarteners came from the area surrounding the school in an upper middle-class neighborhood.

The children were enthusiastic about learning in the classroom and seemed to exhibit an unusual amount of sophistication in the computer lab. When Miss Smith was unable to find the Red Books which contained the instructions for carrying out different LOGO routines and realized that most of the class would not be able to work on the computer that day without them, she drafted three of the focal children to assist her in helping the others get started. They were also seen as competent by their peers, for they were often asked by classmates for help.

Setting. The computer lab was in a large room which contained four tables facing the front of the room and one table which ran parallel to the windows on the right side of the room. The focal children in this study were seated at the side table where they were videotaped usually in groups of four or five.

The lab had 21 TI 99-4A computers, so each child sat at his/her own computer. Students came to the computer lab for one week per month. Miss Smith was assisted by aides who were parent volunteers. Class sessions lasted for approximately thirty minutes.

Data collection. Several types of data were collected. Twelve hours of videotape were made of a focal child using LOGO in the computer laboratory and an additional 10 hours of tape contain the record of their work as it appeared on their monitors. The latter was accomplished with a direct hookup from the focal child's monitor to a videotape recorder. Field notes were also kept which recorded observations from both the computer laboratory and center time in the regular classroom which took place before the children went to the computer lab. As part of center time, Miss Smith gave explanations of that day's LOGO lesson; these were audiotaped. In addition, interviews were conducted with two teachers as well as with six of the children as they used the computer.

Data analysis. The data used for this report consist of two videotapes of the kindergarten focal children, Pete and Kate, using LOGO in the computer laboratory on two different days and two videotapes of their keystrokes and design they made while they programmed. Pete was filmed in March and Kate was filmed in May of 1984. Both children were seated next to each other during each filming. The two sessions in the computer laboratory lasted for a total of one hour and three minutes.

In order to determine how much time each child spent engaged with the monitor working on LOGO versus time spent in other activities, all instances of the focal child's engagement were coded on the first pass through the tapes. Student engagement was defined behaviorally as instances where the student's eye gaze was focused on his/her monitor with one's shoulders parallel to the monitor. The duration of such behaviors was measure by using the running digital numbers on the tapes to calculate totals. The total time engaged was then subtracted from the work time contained on the tape (work time = total time - getting ready + wrap up) to determine the time spent in other activities.

In the second pass through the tapes, the different contexts which occurred in the disengaged time were coded and measured. Percentages were then calculated for engaged versus disengaged time and the particular contexts which each focal child participated in during his/her disengaged time. In successive passes, the following variables were coded: (a) the specific functions of language which the children used in their interactions (coded at the level of a turn of talk), (b) the keystrokes and designs which appeared on the monitor tapes, (c) all instances of soliciting or giving help, and (d) instances of computer-related language used by the children. Occurrences of the above were recorded and analyzed. The number of instances of different language functions were noted, as well as the context in which they appeared. A final step in the analysis of

the data was to review the observations recorded in the field notes which were made in the regular kindergarten classroom. Differences and similarities in the focal children's language and behavior were compared and contrasted.

Preschool Study

Subjects. Six preschoolers were videotaped as they used LOGO in a classroom computer laboratory on the University of Texas campus. The children attended ten hour-long Saturday sessions. Of the six children, two were 5 1/2-year-olds, and four were 4 1/2-year-olds. The two 5-year-olds, a boy and a girl, were selected for this study. All the children attended a Head Start day care program associated with a local community college that serviced children from a low income neighborhood. Except for one child, the 5-year-old girl, the children did not have any prior computer experience. The computer activity experienced by the one child was limited to playing arcade type games on a home computer. Characteristically, the children were very interested and curious about the computer and exhibited none of the fearfulness that is often displayed by adults. Despite the fact that all the children knew one another before the study commenced, incidences of children interacting with one another when they were computing were low. A greater amount of time was focused on the computer, exploring its possibilities and ramifications, than on social interaction.

Setting. Six IBM PC's were situated on three child-sized tables (two computers/table), placed in a semi-circle around the

classroom. Printers were placed behind each computer on an adjoining table. In one section of the room were two toy shelves containing various educational materials, such as puzzles, geo-boards, blocks, and plastic shapes. Some of the games were changed on a weekly basis. The shelves remained closed for approximately the first fifteen minutes of children's computing time, after which time they were opened and accessible to the children. Children could choose to play with the educational materials or use the computer, for the remainder of the time. Frequently, children moved alternately between the toy shelves and a computer, spending the majority of their time at the computer.

Tasks. The children in the preschool study worked with a modified version of Instant LOGO. In this version, hereafter referred to as the Draw program, the turtle was pre-programmed to move in twelve different directions in response to the pressing of individual keys. The directions included up, down, left, right, four diagonal directions at 45 degrees (e.g. up-right, up-left, etc.), and four half-circle directions. Keys were labelled with directional arrows. In addition, single keys could be pressed to clear the screen, erase the last keystroke, or "jump" the turtle so it could move without drawing a line. A further modification was made to the Draw program in the ninth session, which resulted in a functional keyboard change. In this version, the arrow keys caused the turtle merely to turn, and a separate key (labelled with a star) caused the turtle to

advance, and thus draw a line. The change was made in order to introduce the children to a closer rendition of LOGO in which direction and distance commands are separate.

While children could set their own drawing goals using the Draw program, they encountered pre-set goals with three additional computer programs, written by the teacher. The goal of the first program was to move the turtle to a target, a small box which appeared randomly on the screen. Children were rewarded by a "hit" with flashing colors. For the ninth session the "Target" game was modified to incorporate the key changes, and included various targets, such as a rocket and a balloon. A "Maze" game was also available to the children, the goal of which was to move the turtle through a series of roads consisting of horizontal, vertical, and diagonal lines to an end location (home) without going outside of the lines. Children had a choice of five maze games, varying in difficulty level. Lastly, a program referred to as the "Copy" program was introduced to the children. The program drew a simple shape or picture on the left side of the screen and placed the turtle on the right side of the screen so that the object could be duplicated. A single key could be pressed to advance to the next frame in which another picture would be presented. Children could chose from eight pictures/shapes to copy. The purpose of the program was to show children objects that could be drawn with the turtle and give them some practice in reproducing those objects.

Periodically, off-computer activities were initiated by the teacher, in which the participation of all children was encouraged. These activities consisted of felt-board and chalkboard maze games, which offered children opportunities for practicing direction-giving, predicting the desired direction of the turtle, and associating directional symbols with the anticipated direction of the turtle.

Data collection. As in the kindergarten study, several types of data were collected. Ten hours of videotape were collected on a pair of focal children, working side-by-side on computers at a target table. Children were rotated weekly at the target table, so that the camera could capture a representative sample of all the children's computer-related interactions. Fieldnotes were taken on children working at computers which were outside of the focus of the camera. By means of a video hookup to each of the target computers, keystroke activity produced by the focal pair was recorded. Twenty hours of videotape were collected on the children's work at the computer. In addition, a journal was kept by the teacher of the preschool group, in which impressions about the sessions were recorded. Interviews were also conducted with the teacher prior to each session.

Data analysis. Two sources of data were analyzed for this report. These sources consist of videotapes of the focal children, Jackson and Kelly, and their monitor activity from various sessions. Episodes of Jackson's computing time were

taken from the third, fifth, ninth, and tenth sessions; episodes of Kelly's computing interactions were taken from the fifth, seventh, and tenth sessions. A total of 49 minutes on Kelly and 45 minutes on Jackson was analyzed. As in the kindergarten study, the amount of engagement time with the computer versus the time spent in other activities was determined. Engagement time was defined behaviorally as instances where the student's eye gaze was focused on his/her monitor or keyboard. In contrast to the kindergarten study, engagement and disengagement times were not coded in real time. It was discovered that the application of the coding system used in the kindergarten study was too cumbersome to use because of the intermittent nature of the preschooler's attention on the monitor/keyboard. Consequently, a coding scheme was devised which was based upon time sampling. Every 5 seconds the child's behavior was coded as engaged or disengaged. A percentage of the engagement time was calculated by dividing the number of times a child was engaged by the total number of times she/he was engaged as well as disengaged.

In the second pass through the tapes, the activities that the child engaged in when his/her attention was diverted from the screen/keyboard were coded. An activity was coded as task-related if the hild looked at his/her neighbor's work or talked to his/her neighbor or teacher about the task. Behavior was categorized as nontask-related if it involved talk that was nontask-related, looking around the room, or getting out of the

chair to wander around the room. In successive passes, the following variables related to children's talk (which occurred during real time) were coded: (a) the specific functions of language which the children used in their interactions (see examples in Appendix A) and (b) all instances of soliciting and giving help. Because instances of computer language use was rare in the preschool study, it was not coded. The unit of analysis was an utterance, defined as a propositional phrase or complete thought. The number of utterances in each category were noted. The children's monitor activity was also observed and described in order to determine the relationship of the task in which they were engaged to their behavior and language.

Results

Results from the initial study and the preschool study will be presented in the following manner. First, sketches of each child's behavior in the computer laboratory will be given in an attempt to give the reader an idea of how young children behave in that context. In the case of the kindergarten children, a comparison will be made of their behavior and language use in the classroom and the computer laboratory. Comparisons and contrasts will be made between the two children of the same age on all of the variables which were studied. Finally, the kindergarten and preschool data will be compared and general conclusions will be drawn.

Initial Study

The decision regarding which two of the kindergarten children would be chosen for this analysis was made quite easily although all of them exhibited characteristics which were interesting and worthy of further investigation. Pete and Kate seemed to provide an interesting contrast because the ways in which they worked in the computer lab contrasted sharply. This contrast became even more interesting when their behavior in the regular classroom was used as a backdrop. There the two behaved quite similarly, often working in the same group.

Miss Smith's room was arranged in centers where the children worked independently for part of the day. The focal children in our study were bright, enthusiastic learners in the classroom. Four of the six came to kindergarten reading and all of them were reading in pre-primers by the spring of the year. They easily performed the varied tasks required of them at the centers and engaged in almost constant verbal interaction as they worked. The bulk of this talk centered on nontask-related topics. Pete seemed to delight in raising taboo topics or in interpreting the meaning of scatological language for the others, especially the girls. When they expressed disbelief about the veracity of his claims, Pete would assure them that his information was correct because it had been given to him by his older brother.

Pete was also tuned in to popular music and frequently talked about recording artists and current records. Eddie Van Halen was a particular favorite, and he claimed to know the

words of all the songs on side one of a 1984 Van Halen tape (Field Notes [F.N.] 4/11/84). For a time Pete took delight in wearing and calling attention to a punk hairdo he created by wetting his hair and combing it straight up. Pete's behavior in the classroom alternated between very social and playful behavior at the centers and more focused independent behavior in other activities. An example of the latter was recorded in the field notes (F.N. 4/11/84). During reading, Kate, Pete and three others were seated on a rug with Miss Smith doing "round robin" reading. When it was time for Pete to read, he had to be told the place because he had been reading ahead in the story and was not following along with the others.

Kate's classroom behavior was very similar to Pete's. She too was very interdependent and social. She seemed to perform effortlessly and with a high level of confidence in most class activities. When asked what her favorite school subject was, she vacillated between math and reading, finally deciding on the latter (V.T. 5/8/84). She could always be counted upon to do the right thing and to articulate rules and procedures when Miss Smith was unavailable. She handled herself with an air of knowing sophistication and confidence which at times bordered on the officious. During one observation period, she asked one of the investigators if she had all of the children's names spelled correctly in her notes (F.N. 5/9/84)

Kate was extremely verbal in the classroom and could be counted on to have the last word in a conversation. The

following illustrates her quickness and skillful repartee. On one occasion, Pete tried to impress Kate by telling her he had twelve caterpillars to which she countered, "Well, my boyfriend has more than that. He has fifteen." (F.N. 4/12/84) During the same observation period, Pete told Kate that "expletive deleted is a real bad word." Without missing a beat, Kate replied, "Then why do you say it?" These interactions also give one a feel for Pete's playful behavior. Despite the tone of these exchanges, Pete and Kate were good friends who often worked and interacted in the classroom.

Though each child worked alone at his/her computer, a great amount of collaboration occurred. Miss Smith had small red books with modified LOGO Line, Paint, and Sprite programs, which the children used to create graphics on the computer. Executing the programs required the students to enter commands LT for left; FD for forward, etc.) and in some cases parameters such as color and speed in order to produce graphics. Executing a program required the children to interact and use language on many levels: (a) child-hardware, (b) child-software, (c) child-text (the Red Books and messages on the screen), (d) child-teacher, and (e) child-child. Given the demands on the teacher's time and the newness of the tasks, Miss Smith encouraged collaboration among the children. Students were told to "ask their buddies" if they had problems, before asking her. In general, observation in the computer lab showed the students to be engaged in high levels of talk and activity; the students

seemed reasonably adept at manipulating their computers and LOGO.

Pete and Kate's behavior and talk, while similar in the classroom, differed greatly in the computer lab. Pete's behavior in the lab can be characterized as highly focused and independent and less social than in the classroom. In our initial observations of the children in the computer lab, we were struck with how different Pete's behavior was. He stood out from the rest due to his extreme focus and concentration as he used LOGO. Kate, on the other hand, was less independent than in the classroom but equally social. She seemed to delight in interpreting her graphics and those of her friends. She frequently would direct the actions of those around her and collaborate with them as if she had part ownership of their work.

Pete

Types of interactions. Analysis of the one hour and three minutes of Pete's behavior on the two videotapes showed that he spent 84% of his time engaged with the monitor working on LOGO and 85% of his time engaged with the monitor on the other. On one tape, he worked for 7 minutes and 33 seconds at the beginning of the session before disengaging from the monitor to speak to Kate. When he did interact with others, 88% of his interactions were with his classmates. Pete only initiated interaction with Miss Smith 3 times in the 2 taped sessions; twice to draw her attention to his work and once to explain it.

The teacher however, frequently (n=4) asked Pete about his work. The following excerpt illustrates Pete's ability in explaining the graphic he made (see Figure 1):

Videotape 3/9/84

MS: Allright, tell me about your design.

P: Um, it's just a design. I don't know.

MS: How did you make the zigzags?

P: Um, ah, um, see I started down...see I made that (points to the monitor). ( )

T: OK, ( ) You went down.

P: I went L,L,F,L,L,F,F,L,L,L,F,F,...(traces direction on monitor on each direction change)

T: Ok.

P: I went L,L,F,F,L,L,F,F,

M.S. That's fine. Bert, what are you doin'? People?

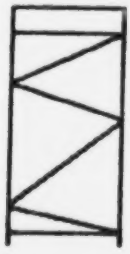

Figure 1. Pete's Graphic

Communicative functions. Examination of the communicative functions of Pete's self-initiated interactions with his peers (n=20) are the following: a) attention-getting (7), b)

interpreting his own work (9), and c) expressing intentionality about what he was going to create (3). He also glanced once at the monitor of a student seated near him without commenting on her work.

Pete was summoned frequently by his classmates (n=22) both for his opinions and for help in solving problems. In his responses, he used the following language functions: a) attention-getting (2), b) expressing intentionality (2), c) commenting on others' work (5), d) explaining something to others (8), and d) in 5 instances summonses were acknowledged only with some form of nonverbal response.

Giving and getting help. Examination of the manner in which help was solicited and given, showed that Pete never asked Miss Smith for help and only asked a student for help once. In the following excerpt Pete asks Kate for help:

Videotape 3/9/84

P: Oh, why won't it do it on mine? (to Kate)

K: (K turns to show Pete how to accomplish the procedure by reaching over and making the appropriate keystrokes on his keyboard.)

While it is not a direct request for assistance, it is the only instance which approximated a request for assistance by Pete from his peers.

Pete was asked three times by his classmates for help. In each case, he gave an explanation of how to solve the problem rather than simply performing the procedure by manipulating the

other's keyboard. The following is an example of such an episode:

Videotape 3/9/84

K: How do you get 'em to back up?

P: (He leaves his seat and stands next to her.) Make it run out of ink. Then stop it and um... type in what you want it to do.

On one occasion, Pete had the floor stolen from him after being asked how to do something. As he was formulating his response, Abbie entered the appropriate keystrokes for Kate before he was able to respond (V.T. 3/9/84).

Kate

Types of interactions. Our initial impression that Kate was less focused and independent in the computer lab than Pete was borne out by videotape analysis. She only spent 59% of the time engaged with the monitor on one tape and 44% on the other. In the latter tape, she spent 31% of her work time (total work time=24:48) getting help from Miss Smith, other students or soliciting help by raising her hand.

Communicative functions. Self-initiated interactions with students comprised 75% of her interactions (n=18). The language function she used most frequently was attention-getting (5) and reporting (5). Other functions which appeared are the following: a) explaining her work and the work of others (3), b) directing (3), and c) requesting (1). One was impossible to code. In interactions where Kate responded to others' initiations, she commented on their work by explaining something

three times, directing their actions twice and confirming something once.

The following is an example of Kate's creativity and how she explained her work to one of the investigators during an interview (see Figure 2):

Videotape 5/8/84

I: Are you experimenting?

K: No. I'm drawing a thing around my necklace.

I: Hum.

K: Around my necklace I got a ( ) somewhere. Here...

I: Those are necklaces?

K: No, this is a U. (points to monitor)

I: And what's this one here?

K: Hum, that's nothin. And this is a....these are hills.

A: Rainbows?

L: No, hills. These are bridges. You can go through this one, and through this one. I'm gonna make something else. Hey, oh I didn't..

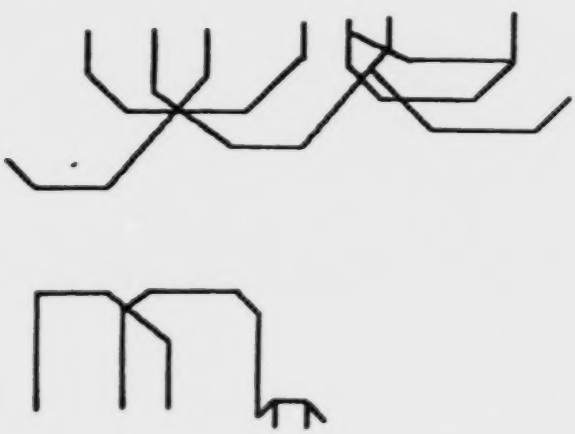

Figure 2. Kate's Graphic

Giving and getting help. Kate, unlike Pete, requested help frequently in the computer lab. In the two sessions, she requested help from peers six times, asking procedural questions each time. She requested help from Miss Smith 9 times by raising her hand but was only successful in getting her attention once. On one of those occassions, a classmate saw that Kate had her hand raised and came to help her (V.T. 3/9/84). On the two occasions when others requested help from Kate, she responded by performing the procedure for her classmate instead of explaining it. Once when a classmate asked Kate how to do something and Kate performed the procedure, her friend replied, "Can't you just tell me?" (V.T. 5/84).

Kate frequently gave unsolicited help to those around her (n=8). Her advice most often consisted of mapping intentions upon others' work (n=4); interpreting it (n=2); or explaining a procedure (2). The following illustrates Kate's giving unsolicited help:

Videotape 5/8/84

K: Hey, what are you doin'? (to P) Make it go straight down now. Make it go straight down.

A: What are y'all doin', Paint?

K: No, ...yeah. You're makin' a Christmas tree. (to P) Go straight down now and you'll make a Christmas tree.

Kate's help was not always accepted so well however, as the following example illustrates:

Videotape 3/9/84

K: (Glances over at Abbie's monitor and reads the prompt) It says, "Out of ink."

A: I know! (Said emphatically as she leans across the table toward Kate).

Computer language. Throughout the data corpus, computer language causes glitches in communication either in speech between the teacher and children or among the children themselves. Communication problems also occur when complicated written prompts appear on the computer monitors. Three instances occurred in the 1 hour and 3 minutes of tape used in this analysis. The following illustrates problems which arise in both speech and text due to the use of computer terms.

Videotape 5/8/84

K: "Tell me how to see". (Reads monitor prompt.)

MS: What do you wanna do, Kate?

A: Why it always says, "Tell me how to see?"

MS: It's a program bug.

K: A pro..

MS: It just does that.

K: A pro, a pro, a pro,... a program bug.

Kate's halting pronunciation of the term program bug was accompanied by quizzical looks and averted eye gaze as she tried to interpret the meaning of the strange new term. In oral communication, communication breakdowns are easily and quickly repaired. The inability to comprehend computer language contained in the text of the computer prompts caused the children a great deal of frustration and often lead to lengthy

standstills in the computer lab. While they could read the words contained in prompts such as "Tell me how to piant (sic)," they had problems in interpreting its underlying message, "You spelled the word paint incorrectly." On the whole, the children learned computer related language quickly and used it frequently in their interactions with each other.

Preschool Study

An interesting comparison of individual learning styles and skills could have been made between any of the preschool children. Kelly and Jackson were selected because they were the only two 5-year-olds in the study, and for comparison purposes they were closer in age and skill levels to the children in the kindergarten study. A somewhat shy, self-contained individual, Kelly was quiet, low-keyed, but also self-assured. Kelly's enabling skills, particularly spatially related skills, allowed her to quickly master LOGO commands to produce drawings. Demonstrating an ability to identify a directional symbol on each key with its correspondence to the direction of the turtle, Kelly easily learned to control the turtle's movement on the screen. In addition, her knowledge of spatial features of objects enabled her to frequently anticipate those turtle steps needed to construct a drawing and her sense of direction helped her to achieve the object of spatial games. The yo ngest in a family of four children, she enjoyed demonstrating her computing skills to her siblings and parents when they arrived to pick her up from the sessions. Kelly's family was overwhelmingly

supportive of her computing experiences, showing a lot of interest in her work and giving her praise for her accomplishments. Kelly's mother was particularly awed by Kelly's computer expertise, and expressed hopes that she would have an opportunity in school to continue computer learning.

Playful, assertive, and verbal, Jackson delighted us with his flamboyant antics. Sometimes he would interrupt his involvement with the computer to flash a wide-toothed smile for the benefit of the camera, or burp into the microphone. Though he was very interested and frequently focused on his computer work, he often watched and commented on his peers' work, sometime taking the liberty to reach over and press some keys on his/her keyboard. While Jackson was much more outgoing than Kelly, he was less confident of his abilities and far more dependent on teachers and peers for help and ideas. In contrast to Kelly's calm quiet nature, Jackson often expressed frustration or talked to himself while he worked. He had trouble selecting the appropriate directional symbol for a desired direction, and also had problems predicting the steps needed to produce a recognizable drawing.

Kelly and Jackson were similarly drawn to the computer. Their working styles can be described as focused, purposeful, motivated, and persistent. While the other preschoolers were also quite interested in the computer, their spurts of random or inconsistent behavior contrasts sharply with Kelly's and Jackson's interactions with the computer.

Kelly

For most of the sessions, Kelly was extremely focused on the computing task, infrequently initiating conversation and often responding to requests with a quick glance, or a short utterance. Characteristically, Kelly demonstrated competence in her performance, rarely asking for assistance from adults or peers. Two episodes that typify this behavior were selected from the fifth and seventh sessions and analyzed. Two additional episodes from the seventh and tenth sessions were also analyzed because they provided rare examples of Kelly's social skills in relating to peers and her ability to seek and provide help.

Session Five

Types of interactions. In the first episode, Kelly was working with the Maze game. This episode lasted 11 minutes, from the time Kelly sat down at the computer to the time she was called away by the teacher to participate in an off-computer activity. During this time, Kelly was engaged with the computing task 85% of the time. When her attention was not on the screen or monitor, it was focused on a task-related activity 13% of the time (see Appendix B for the percentages of task-related and nontask-related behavior for preschool children). Methodically, Kelly pressed the appropriate key, watched the consequence on the screen, and predicted the next key press. Mistakes were rarely made and when they occurred were corrected by pressing the erase key, instead of clearing

the screen and starting all over. Her purposeful, methodical approach to the computer, intense concentration on the task, and efficient use of the erase key to correct mistakes characterized Kelly's working style.

Communicative functions. Even though the teacher was kneeling behind her for half of her computing time, and someone was seated next to her for the whole time, Kelly only uttered one comment (to her peer), which was inaudible. During times when her attention was averted from the screen, Kelly primarily watched her peer's monitor and listened to the teacher talk to her or to her peer. Kelly's quiet observance of her surrounding environment was a behavioral trait which persisted throughout the sessions.

Session Seven

Types of interactions. When Kelly first arrived in the lab, she worked with the Draw program. She immediately set out to draw the letters in her name, a task that she had partially accomplished in the previous session. Kelly spent 6 minutes drawing all the letters in her name, after which time she left the computer to watch the printout of her completed task. The activity commanded Kelly's concentration as she was engaged 80% of the time. Surprisingly, the letters in her name were flawlessly executed. The only difficulty experienced was letters "wrapping" (going off-screen and appearing on the opposite side), due to the fact that her starting point had been the middle of the screen. She solved the "wrapping" problem by

erasing the letter and moving to another location to draw it, resulting in letters being placed somewhat haphazardly on the screen. Towards the end of the session she drew her name again, but made sure she had enough room by moving the turtle to the far left of the screen before starting her name.

Her disengagement time was highly task-related (19%). Half of that time was spent voluntarily removing her attention to watch or listen to her peer; her attention was averted the remaining half of time by a peer requesting information and attention.

Communicative functions. Kelly's communicative talk was quite limited (n = 3) in this episode. She offered one unsolicited solution to a problem experienced by her peer, and one solicited answer to a request for help. She once reported what she was working on to her peer in response to a request.

An example of her response to these requests is presented below:

D: Look it! (D points to her screen, K does not look)
(D looks at K's screen)
What are you making?

K: My name.

D: Your name?
Is your name 'K' 'E' ...then what?
(K continues to work, D turns to work on her own computer, then turns back to K)
How did you do dat?
How did you turn it in?

K: Push this one.
(K places her finger on a key on her own keyboard, then resumes working)

Session Seven

Types of interactions. When interacting with an unfamiliar, more complex task during the latter part of the seventh session, Kelly's engagement period decreased to 58% of the time spent on the task. Kelly worked for the first time with the Copy program. All the children encountered difficulty with the task, needing information about initial and subsequent steps for completion. Kelly was the only child who could complete some of the steps independently. During the time she was not engaged with the program, Kelly watched and listened to the teacher give instructions to a peer and quietly interjected questions while patiently waiting for an answer.

Communicative functions. Kelly commented to the teacher 100% of the time, reporting on her work or progress (n = 5) and requesting help (n = 11).

Getting help. The following example illustrates Kelly's quiet determination to seek information relevant to the problem:

K: How do you try this one?

T: (T momentarily diverts her attention from G to address K)
How do you start out with that one?
(T resumes helping G before answering, K watches T instruct G)

T: Um...just start with that key.

T: (T turns her attention again to G)
Oh hang on...just wait a second...
it takes a little bit of time.
There we go. Oh --

K: -- I started with this.

T: Ok...now...do you need to press it one more time you think?

K: (K nods and presses key)

T: Ok...now what...what do you need to do?

K: Press this key?
(K points to key, turns to look at T, but finds T's attention on G)
Press this key. (said louder to T)

T: Go ahead and try it.

Session Ten

Types of interactions. The last session was atypical of Kelly's interactions because of the decreased amount of time she was engaged with the computer (48%) and the increased amount of time spent in social interchange. Kelly spent the first 20 minutes of the session using the Draw program to draw pictures in reponse to the teacher's request to draw something "easy" and then "hard." In response to the request to make something easy, Kelly drew boxes ("TV's") in various sizes. Her hard drawing was a "house with a ball on top." She subsequently added one more peak with a ball on top (see Figure 3).

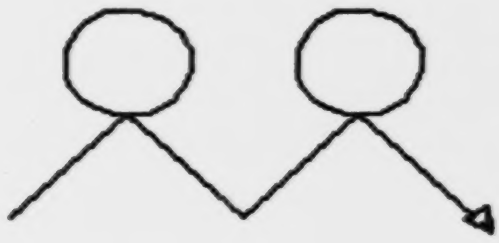

Figure 3. Kelly's Graphic

Communicative functions. The communicative functions (n = 53) used by Kelly in this session were as follows: a)

requesting (11), b) explaining (17), c) intending (5), d) interpreting (5), e) reporting (4), f) assessing (2), g) commanding and directing (6), and h) attention-getting (3). Kelly initiated speech 57% of the time and responded 43% of the time. Responses primarily consisted of giving help.

Giving help. In response to Jackson's question, "How she do dat?" the teacher prompted Kelly to "tell" Jackson. Kelly explained in a step-by-step fashion how to execute her "hard" drawing, often showing Jackson which key he needed to press by pointing to it on her keyboard. Furthermore, she exhibited effective teaching skills through her attempts to monitor Jackson's readiness for the next instruction by looking at his screen to see if he had completed the previous step. At one point she asked him, "Are you ready to go up?" in response to his question, "Now what?" The following exemplifies a teaching episode that ensues in response to Jackson's question, "How she do dat?":

K: (K looks at J's monitor)
You hafta go back down.

J: Ok...dis one? (J points to key on his keyboard)

K: (K nods, then looks back at his monitor)

K: Now press the star.

J: Now what?

K: This one. (K points to key on her keyboard, J leans over to look at her keyboard)

Kelly appeared to be aware of her computing competence and her facility with computing tasks. Twice in this episode she

responded to Jackson's inquiry about how to do something with the comment, "Eeeeasy" (the first syllable is drawn out for emphasis). This comment provides a glimpse into Kelly's awareness that she is more knowledgeable than Jackson. The fact that she informed Jackson of her knowledge is striking, since she rarely drew attention to herself and her capabilities throughout the study.

Kelly also initiated conversation by asking Jackson questions about his computing work. Most often Kelly was intent on finding out what Jackson was drawing:

K: What is it?
(said in reference to what J had drawn on his screen)

J: I don't know.

K: Then whyd ya make it?

J: I don't know.
Whyd ya make <u>that</u>?
(said in reference to what she had on her screen)

K: I <u>making</u> something.

This example highlights a primary difference between Kelly's and Jackson's approach to computing tasks. Kelly was frequently goal-oriented, and sometimes announced an intention to draw something before attempting it. For instance in this episode she declared her intention to draw a number of pictures. On the other hand, Jackson's pictures evolved as he was drawing them. He infrequently expressed intentionality or attached meaning to his drawings. Kelly seemed to be aware of the differences and apparently assigned more importance to her work by implying that she was being productive, while he was not.

Jackson

During data collection, Jackson missed not one of the ten hour-long Saturday morning computer sessions. His mother reported that Jackson looked forward to each session with great anticipation. Unlike Kelly, Jackson initially lacked confidence in his ability to get the turtle to do what he wanted it to do. However, Jackson was confident about soliciting help from the teacher and his peers when he was unsure about what to do next at the computer. Episodes from the third, fifth, ninth, and tenth sessions were selected for analyses. The types of interactions in which Jackson participated were noted. Each segment was fully transcribed and then used to identify the communicative functions Jackson used when he communicated with his peers and his teacher.

Session Three

Types of interactions. In this session, the teacher suggested that Jackson show Carolina how to play a new game, the Target game. This episode was brief; it began when the children initially sat down at their respective computers and ended when Jackson walked away from his computer 7 minutes and 10 seconds later. During this segment Jackson was engaged with his computer 56% of the time, engaged in task-related behavior (such as watching or interacting with Carolina and "fiddling" with his computer monitor knob) 34% of the time, and engaged in nontask-related behavior 10% of the time.

Communicative functions. The communicative functions used

by Jackson in the third session (n=20) included: a) reporting his own actions (5), b) directing (2), c) drawing attention (3), d) assessing (3), and e) requesting (7); 6 were requests for confirmation of Carolina's understanding of the Target game.

The following demonstrates how Jackson used requests for confirmation while he was showing Carolina how to play the Target game:

J: (looks at C with a big grin on his face and resumes typing)

C: (watches J)

J: Do you get it?

J: (C looks at J, but does not indicate that she understands)

J: Huh?

C: (looks at J as J continues to press keys)

J: You get it?

C: (looks at J and barely shakes her head "no")

J: No?

At this point the teacher joined the children and helped Carolina learn how to play the game by asking additional questions. However, a few moments later, Jackson (using a pointing strategy) offered Carolina additional "help":

J: That way (pointing to the left with his thumb and reaching over and pressing a key on C's keyboard).
Oops (holding his hand over his mouth as if he did something wrong).
This (reaching over and pressing another key).
See?

Session Five

Types of interactions. This session began with an off-computer activity at the chalkboard. Approximately half an

hour into the session, Bobby was sitting at one of the focal computers working with the Draw program. Jackson expressed interest in what Bobby was drawing by asking: "How you make that, Bobby?" His question marked the beginning of the segment selected for analysis and ended 9 minutes and 55 seconds later when Jackson got up and made a noise into the microphone. During this session, Jackson was engaged with his computer 50% of the time, engaged in task-related behavior 28% of the time, and engaged in nontask-related behavior 22% of the time. Jackson's task-related behavoir included either watching Bobby work, looking toward Bobby's screen, or pressing Bobby's keys for him.

Communicative functions. Analysis of the session indicated that Jackson's talk included the following communicative functions (n=27): a) reporting (15), b) directing self and other (7), c) requesting information/action (3), and d) assessing (2).

During this session, Jackson requested information from Bobby about some boxes Bobby was drawing on his screen:

J: How'd you make that?

B: Wan me to make it?

J: Huh?

B: Wan me to make it for you?

J: Ya.

B: Wait, let me finish.

J: You goin the wrong way ().

B: I just making this, that's why.

J: (inaudible)

B: Ok, I do it for you (B moves over closer to J and uses J's keyboard).

In the following episode, Jackson appeared to deny his ability to draw what he wanted and expressed this frustration through his choice of communicative functions, as well as his body language:

T: ---Hey, you got a box on there.

J: I didn't do dis. Bobby did.

B: Look it, I'm beating you (laughs).

J: I can't do it. Do it for me, Bobby (as J kicks B's chair with his foot).

The richness of the data is evident in the next episode which took place when a "bug" made its presence known (the bug being colors flashing when the turtle crossed a particular location on the screen, similar to the Target game) and, in the process, deleted what Jackson had made on his screen. Note how Jackson obtained assistance from the teacher:

T: Here...let me...let me fix this for you (as she retypes commands for the Draw program). Ok?

J: Wanna make mine like Bobby's.

T: Ok. Go ahead.

J: I say... you.

T: Well, why don't you...you start out and I'll give you some...some help with it.

J: How ya do it (said very quietly as he starts pressing keys)?

This example lends additional support to the notion that Jackson was reluctant at times to use the computer without much

assistance, either from the teacher or his peers.

Session Nine

Types of interactions. During this session, Gabriella challenged Jackson to make a design at least as big as hers. And much to his surprise, he did! In the process of arriving at this goal, Jackson was engaged with his computer 68% of the time, engaged in task-related behavior 24% of the time, and engaged in nontask-related behavior 8% of the time. Sixty-three percent of his task-related behavior consisted of interactions with Gabriella as she dared Jackson to compete with her.

Communicative functions. Jackson exhibited the following communicative functions (n=43): a) directing (16), b) reporting (11), c) assessing (8), d) requesting (7), and e) attention getting (1).

During this session, Jackson and Gabriella were introduced to a modified version of the Target game. Jackson relied on self talk (or verbal cueing) to direct his actions in maneuvering the turtle to the target:

G: (looks over at J's screen)

J: See what I did?

G: (does not respond and types quickly on her keyboard)

J: Oops! Oops! Ahh...up. This way. This way (sighs)

A few moments later, when Jackson directed the turtle to the target through the two-step procedure, his sense of pride in accomplishing this task was evident:

J: I did it! Neat! (Then slumping back in his chair and

folding his arms across his chest) Uh, uh. I ain't gonna do that no more.

Self talk also helped Jackson express his competitive spirit...at least to himself...when Gabriella egged him on in the following episode. Jackson used a variety of communicative functions during this episode (e.g. requesting, reporting, assessing, attention getting, and directing):

G: Na, na, na, na, na, na (in teasing tone). I made a box (or cross?).

J: How'd you make that?

G: I made it go back down (traces design on screen with her finger).

J: (Shrugs shoulders) Watch dis (in a cockey tone...as he resumes typing)

G: (Looks at J's screen) Can't you do it?

J: Yea, I can. I can (push) down.

G: You have to press the star (key) again. Let it go back down.

J: (inaudible)

G: I got a big one. I got a big box (or cross?) (as she traces it on her screen with her finger on her monitor screen).

J: I can make a big one, too. Mine also got all the way down.

G: Uh, uh (no). Mine is all the way down (tracing her finger down the screen).

J: (Studies G's screen)

At this point the teacher appeared and began to talk with the children about how they were doing, but quickly redirected her attention to another child needing help. Meanwhile Jackson kept working at his computer and could be heard saying under his breath a few moments later:

J: There. Now I made a big one (said in a "so there" tone)! And it's bigger than yours.

Session Ten

Types of interactions. The last session analyzed is unique because it involved both Jackson and Kelly. It also represented the longest continuous segment studied (20 minutes). In this segment, Kelly functioned in a teaching role and Jackson was predominantly the learner. However, there was a brief exchange in which Jackson directed Kelly through some steps. Overall, Jackson was engaged with his computer 57% of the time during this session; task-related behavior comprised 29% of time, while nontask-related behavior involved 14% of the time.

Communicative functions. In addition to reporting, requesting, assessing, directing, and attention getting, examples of three new categories of communicative functions surfaced during this session. Analysis of Jackson's talk during this segment revealed the following communicative functions (n=96): a) requesting (32), b) reporting (30), c) assessing (15), d) directing (8), e) attention getting (3), f) commanding (4), g) intending (2), and h) interpreting (2).

The following examples clarify these changes. First, commands such as "Stop!" and "Wait!" appeared for the first time. Second, James finally expressed intentionality when he said, "I know what I'm gonna make." This statement is striking because prior to this session Jackson had not expressed any intention about what he was going to draw. Third, a significant instance occurred during this session when Jackson used the

interpreting function to describe the "balloons" (see Figure 3) he imaginarily "picked" from the screen:

J: This goin...these are balloons (putting his hands on the screen, pretending to "pick" the balloons with his hands).

K: Those are balloons.

J: They bust (throwing his hands above his head, releasing the imaginary balloons, while making explosive sounds).

Giving and getting help. Although Kelly's teaching ability seemed to be advanced for her age, she was not alone in displaying such skill. In the tenth, Jackson initiated a "teaching" episode when he offered to show Kelly how to do something:

J: (Reaching over and pressing K's keys) Oh. Oh...let me show you how to do--

K: --What?

J: (Taps her keys) Oh...I did it the wrong way.

K: Well...I can do a triangle.

J: Now...do it myself (working on his own computer).

K: I think I will make a space ship.

J: (Pressing K's keys again) One more...push one more.

In this episode, Jackson directed Kelly through his choice of words, as well as through his actions. This is markedly different from the example highlighted in the third session where Jackson "helped" Carolina; there he did not tell her what to do by verbally directing her actions, but rather demonstrated for her how to play the Target game. While he sought information from Carolina through requests for confirmation of her understanding, he provided information to Kelly. When

"teaching" Jackson, however, Kelly refrained from "taking over" his keyboard; rather than perform the actions for him, she explained the steps needed to accomplish a goal.

Discusssion

The preschool study is not a replication of the kindergarten study, and thus differs on a number of variables, such as type of setting and teacher/child ratio. The salient features of each study will be discussed, and where possible, children's language use and behavior will be compared and contrasted.

The kindergarten children's competence in managing their computing environment was striking and their enthusiasm and confidence evident. LOGO for these children, presented a myriad of learning opportunities in a short period of time that seem well suited to problem solving as well as utilizing language and social skills. Previous experience with the computer in the lab and a working knowledge of the tasks, acquired prior to the data collection, contributed to the ease with which these children computed. The children seemed to take delight in talking to each other about what they knew and what they were doing. The collaborative behavior, which flourished in the kindergarten lab, was encouraged by the kindergarten teacher's verbal prompts and her relative inaccessibility; it was empowered by the children's sophistication and knowledge. In general, this study strongly supports the findings of previous reports that LOGO invites collaboration while learning and that computing

continues to be a social activity even after the novelty wears off.

In contrast to the kindergarten children, the preschool children were neophytes in the world of computing and thus less confident about their computing capabilities. Much time was spent exploring the hardware and software in an attempt to discover and learn what computing and LOGO were all about. Interaction with the computer and the teacher took precedence over interaction with peers. Children did not talk very much about their work and engaged infrequently in collaborative behavior. The sustained interaction between Kelly and Jackson on the last session seemed to be due to an increased confidence in their computing abilities and a desire to communicate this knowledge to one another.

In general, preschool children were more responsive to LOGO's holding power than to its social features. This finding contrasts sharply with reports that the computer, as a delivery system for drill and practice software, enhances the expression of interactive skills among preschoolers. Glimpses of emerging social skills during the last session lead us to believe that the children would have become increasingly verbal and interactive as they gained more computing experience and knowledge. We also believe that communicative skills that develop as a function of age and experience, would contribute to an increased level of social interaction and collaboration. The facility with which kindergarten children verbalized

explanations and used computer language, which was specific to the problem, contrasts with the preschooler's reliance on performatory behavior with few explanations and rare use of computer language. The difference between older and younger children's communicative skills parallels Cooper's (1980) observation that collaboration is facilitated by referentially specific and informative language, and that this is used much more frequently by older children.

The sustained attention upon a computing task and the amount of time spent working at a task were features shared by children in both the studies. This was an especially interesting trait of the preschoolers, since they had an option to choose other activities in lieu of the computing activity. Papert's (1980) contention that LOGO can be an engaging, motivating activity even for children as young as 4 years, is borne out by the children in this study. However, LOGO is engaging only to the extent that children have some knowledge about its possibilities. In contrast to Muller and Perlmutter's (1985) finding that teacher input was minimal when preschool children used drill and practice software, the preschool teacher in this study played a major role in supporting children's learning and involvement with LOGO. We plan to investigate this role in a subsequent study. A focus of yet another study will be the effect of LOGO upon children's cognitive learning, which will be accomplished by looking much more closely at the monitor tapes.

In summary, LOGO was found to be an appropriate and beneficial activity for two kindergarten and two preschool children. For the kindergarten children, LOGO created a rich context for the expression of language and social skills with minimal teacher supervision. Repeated viewings of the videotapes of other focal children led us to believe that their experience with LOGO was similar to that of the children in this paper. However, it must be pointed out that these kindergarten children were high achievers and their experiences may not parallel other kindergarteners' encounters with LOGO. For the preschool children, LOGO provided an engaging activity which fostered a high degree of task-related behavior. As a result of the computing experience, the children developed a number of sophisticated computing skills and a sense of confidence about those skills. Language used to convey information about their computing experience was slowly emerging. Just as developmental differences related to collaboration surfaced between the older preschool children and kindergarten children, differences appear to exist between the younger and older preschool children. Observations of the younger preschool children lead us to believe that while they were engaged with the computer, they were involved to a lesser extent than the older preschool children and were less likely to seek help from a peer and give verbal assistance.

References

Campbell, P. F., Fein, G. G., Scholnick, E. K., Frank, R. E., & Schwartz, S. S. (1985). Spatial perspectives on Logo learning. Paper presented at the annual meeting of the American Educational Research Association, Chicago, Illinois.

Cooper, C. R. (1980). Development of collaborative problem solving among preschool children. Developmental Psychology, 16(5), 433-440.

Erickson, F. & Shultz, J. (1977, February). When is a context? The Quarterly Newletter of the Institute for Comparative Human Development, The Rockefeller University, 1(2), 5-10.

Erickson, F. (1982). Classroom discourse as improvisation: relationships between academic task structure and social participation structure in lessons. In L. C. Wilkinson (Ed.), Communicating in the classroom. New York: Academic Press.

Fein, G. G., Scholnick, E. K., Campbell, P. F., Scwartz, S. & Frank, R. (1985). Computing space. Paper presented at the Jean Piaget Society Symposium, Philadelphia, Pennsylvania.

Genishi, C., McCollum, P., Hamilton, S., & Strand, E. (1985). An observational study of young children and Logo. Paper presented at the annual meeting of the American Educational Research Association, Chicago, Illinois.

Hawkins, J., Sheingold, K., Gearhart, M., & Berger, C. (1982). Micros in schools: Impact on the social life of elementary classrooms. Journal of Applied Developmental Psychology, 3, 361-373.

Kull, J. A. (1985). Programming, problem-solving, and mathematical learnings in young children learning Logo: A collaborative, qualititative study in the first grade. Paper presented at the annual meeting of American Educational Research Association Chicago, Illinois.

Mehan, K. (1979). Learning lessons, social organization in the classroom. Cambridge, MA: Harvard University Press.

Muller, A. & Perlmutter, M. (1985). Preschool children's problem solving interactions at computers and jigsaw puzzles. Journal of Applied Developmental Psychology, 6, 173-186.

Munro-Mavias, S. (1983). Computer programming by kindergarten children using LOGO. (Report No. IR-010-893). Paper presented at the Association for Media and Technology in Education in Canada/ADATE Confluence. (ERIC Document Reproduction Service No. ED 237 066).

Papert, S. (1980). Mindstorms: Children, computers, and powerful ideas. New York: Basic Books.

Piestrup, A. M. (1982). Young children use computer graphics. (ERIC Document Reproduction No. ED 224 564).

Rosengren, K., Gross, D., & Abrams, A. (1985). An observational study of preschool children's computing activity. Paper presented at Perspectives on the Young Child and the Computer, University of Texas at Austin.

Schwartz, S. L. & Leibson, R. (1985, April). Kindergarteners having microcomputer experiences: A descriptive study. Paper presented at the annual meeting of the American Educational Research Association, Chicago, Illinois.

Swigger, K. (1983, Nov-Dec). Is one Better? Educational Computer, pp. 12-13.

Appendix A:
Categories of Communicative Functions

Reporting:	I beated you. There's a "d.". I already made dis one.
Directing:	That way. Do it for me, Bobby. Backwards. Backwards.
Assessing:	I can't do it. Oops, I did it the wrong way. That's easy.
Commanding:	Wait! Stop! Don't.
Requesting:	Oh, how do you make that? Did you get it? Now how you make that circle?
Attention getting:	Look! Look! Watch me! Look, I made it up and back.
Intending:	I think I will make a space ship. I gonna make something. I can make a small TV.
Interpreting:	...some bubbles. These are balloons. I made a sucker.

Appendix B: Percentages of Engagement vs. Disengagement Time

CHILD: Kelly

SESSION	5	7	7	10
TIME:	11	6:27	11:40	19:50
ACTIVITY IN PROGRESS:	Maze	Draw	Copy	Draw
ENGAGED WITH COMPUTER	85%	80%	58%	48%
ENGAGED ELSEWHERE				
TASK-RELATED:	13%	19%	37%	42%
NONTASK-RELATED:	2%	1%	5%	10%

TOTAL: Engaged = 67.5%
Engaged elsewhere: Task = 28%; Nontask = 4.5%

==========

CHILD: Jackson

SESSION	3	5	9	10
TIME:	7:10	8:55	9:00	20:00
ACTIVITY IN PROGRESS:	Target	Draw	Target	Draw
ENGAGED WITH COMPUTER	56%	50%	68%	57%
ENGAGED ELSEWHERE				
TASK-RELATED:	34%	28%	24%	29%
NONTASK-RELATED:	10%	22%	8%	14%

TOTAL: Engaged = 57%
Engaged elsewhere: Task = 29%; Nontask = 14%